

DENTURE ADHESIVES : A REVIEW

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Dental professionals have been slow to accept denture adhesives as a means to enhance denture retention, stability and function. Despite considerable documentation advocating patients use of adhesives, many dentists view adhesive usage as a poor reflection of their clinical skill and prosthetic expertise.

This article traces the emergence and growth of denture adhesives and is designed to provide the dental profession with a better understanding of adhesive products and their application to patient treatment.

EMERGENCE AND GROWTH OF DENTURE ADHESIVES

People began using denture adhesives in the late 18th century but the dental literature does not mention these products until the 19th century, when they entered the dentist's armamentarium. The first US patent for a denture adhesive was issued in 1913.^{1,18}

Despite the wide spread use of adhesives, dentist continued to maintain a negative attitude towards these products. This attitude was demonstrated in an article published in 1945 that listed 3 reasons for the use of adhesive powders :

1. To hold base plates while recording dental relations.
2. In immediate denture construction until well fitting dentures were completed.
3. When the dentist is incompetent or incapable of making a tight fitting denture.¹¹

Mechanism of Action

To understand today's adhesives, we must first explore the mechanism by which they work. Shay described in his article, that the material swells 50 to 150 percent by volume in the presence of water, filling in spaces between the prosthesis and the tissues. As water is absorbed by the adhesive agents, the resulting anions are attracted to cations in mucous membrane proteins, producing stickiness.

The properties of current adhesives depend on a combination of both physical and chemical forces. The physical forces are based on the principle derived by Stefan over a century ago, which states that the forces required to pull two discs or plate apart is directly proportional to the viscosity of the liquid between them. Saliva increases the viscosity of the adhesive thereby increasing the force required to separate the prosthesis from the oral surface.

Modern adhesives increase this force by using materials that provide strong bioadhesive and cohesive forces. Most adhesives use ingredients that provide bioadhesion via carboxyl groups. As the adhesive hydrates, free carboxyl groups from electrovalent bonds produce the stickiness. Polymethyl Vinyl ether-maleic anhydride, or PVM-MA, copolymer is a synthetic compound widely used in denture adhesives because of its high level of carboxyl groups. Sodium carboxy methyl cellulose, or CMC, a naturally derived adhesive ingredient, also is commonly used because of being more soluble in water than PVM-MA salts. Although it provides a strong initial hold when used alone CMC

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quickly dissolves due to its high level of solubility.

Beginning in the early 70's manufacturers combined divalent salts of PVM-MA specifically calcium salts with CMC to make denture adhesives. This combination provided quick upfront hold through the action of CMC and a hold of longer duration through the use of the PVM-MA divalent salts. The divalent salts not only increases product performance by reducing the rate of dissolution, but is also increased the cohesive strength of the overall material by developing a highly cross-linked matrix between the CMC, PVM-MA, Co-polymer and divalent calcium salt.^{9,10}

In the late 80's manufacturers introduced products that combined PVM-MA Zinc and Ca salts with CMC. These materials provided even greater cohesive strength for longer duration's because of the stronger covalent bond that develops via the divalent zinc cation. Commercial denture adhesives that contain these materials have been clinically proven to provide stronger and longer hold than products containing Ca salts of PVM-MA copolymer alone.

Denture adhesives have become the fact of life for practically millions of denture wearers and for thousands of dentists who treat them or as Tautin put it "Denture adhesives will be with us until we eliminate the need for complete denture".

The major problem with denture adhesives is not their effect on tissues not the result of their long term usage, nor even their effect on vertical dimension; it is that the dental profession knows so little about them.

Usage of adhesives is often related to the denture wearer's stage of adjustment and stage of adaptation. Denture wearer seeks physical fit and comfort, as well as emotional security and confidence. Adhesives permit some denture wearers the ability to successfully manage their dentures in a way that reduce the sense of

loss of control, allow them to feel the denture less artificial and therefore under their command.⁵

Samuel Yankel in 1889 classified dentures into two categories according to the salivary contribution for adhesion as

1. Adhesives dentures (aided by saliva)
2. Friction dentures (by use of clasps)

In 1951 components such as springs, gum tragacanta, vacuum chambers, Eureka suction cups were incorporated in dentures for retention. They were also grouped into two groups according to their solubility as :

1. Insoluble
 - (a) Mixes of powders to form pastes.
 - (b) Dentures pads - gauze dipped in wax.
 - (c) Softened paste within the tube that can be shaped and hard dry synthetic wafers.
2. Soluble - as pastes, mixes and creams.¹³

ROLE OF DENTURE ADHESIVES

Denture retention has been defined as the resistance to vertical and torsional stresses, or the resistance to a denture to removal in a direction opposite to that of its insertion. Retention relates to the forces that are necessary to completely remove the denture that tend to alter the position of the denture on its osseous support. Thus the denture that moves about during chewing lacks stability, even though it may be retained during the process.⁷

Kapur in 1967 stated that denture adhesive unequivocally increased denture retention thereby improving denture wearers incisive ability. He also suggested that factors other than loss of retention such as the inefficient manipulation of food during chewing as a result of reduced oral sensitivity might contribute to deficient chewing ability in denture wearers. He believed these products can give patient an

increased sense of security, added comfort and a subsequent perception that masticatory performance is improved.⁸

Although denture adhesives have been with us for a long time, their use and abuse, advantage and disadvantage have been more a subject of hypothesis than of accurate documentation. Today various studies are carried out, to check the effectiveness of these materials by scoring the denture retention and stability.^{3,12,15-17}

1. Radiotelemetry - to measure pressure at the denture base - mucosa interface.
2. Counting denture dislodgement's during chewing.
3. Cineradiographic technique - to measure retentive forces using hydraulic and electrical system with an extra oral transducer.
4. Kinesiographic technique - study retention in vivo.
5. Gnathodynamometry - to test biting force.

All these studies concluded that a denture adhesive can be of considerable benefit to many denture wearers even those with good quality denture support tissues. Subjectively the denture adhesives provide confidence and objectively it allows development of needed forces in biting and chewing of foods 35N-54N.

TISSUE IRRITATION AND BONE RESORPTION

Many patients derive a sense of security from the use of denture adhesives. While there are some indications for their use, they are few. When it is impossible for patients to retain dentures because of marked loss of oral structure resulting from surgery, accidents or diseases, denture adhesives are indicated. The occasional use of a denture adhesive by patients who are expecting an unusual experience is justified. Marked anxiety states often cause a

transient xerostomia with concomitant loss of denture retention.

A valid reason for discouraging even the occasional use of denture adhesive is that the patient may become dependent on them. Most patient can learn to use their complete denture with adequate proficiency without having to rely on denture adhesive if they are willing to make the effort.

In addition to being messy and somewhat expensive, their continuous and unwarranted use can be very harmful. The use of denture adhesives makes it possible for the patient to continue wearing ill-fitting dentures, which often become instruments of vicious oral abuse and destruction. Patients resorting to the use of denture adhesives, instead of seeking needed maintenance therapy, invite serious harm.⁴

The retention provided by denture adhesives permits many patients to use their dentures with such vigor and force that even well fitting dentures may severely challenge the health tolerances of the supporting tissues. When a patient's general and oral health tolerances are low or marginal, functional forces must be reduced if oral health is to be maintained. There are many over the counter product available for altering the fit and function of prosthesis. They have often been lumped together and accused of destroying bone or at least of causing bone changes.

Boone suggested that these products be divided into appropriate categories, separating the insoluble products that have been implicated in the tissue irritation and bone resorption from soluble agents like denture adhesives. The insoluble groups include denture pads, or synthetic wafers and products that serve, as home relining materials. A variety of home made devices that may combine all sorts of materials form softened toilet paper to insoluble plastic denture adhesive that can cause frank ridge resorption.²

The soluble denture adhesives gradually dissipate by dissolving patient saliva. The physical characteristics of these denture adhesives allow them to flow under pressure, spread over the denture and eventually dissipate. Unlike the insoluble products these denture adhesives tend to distribute the denture load more evenly on the supporting tissues. This distribution provides a cushioning effect.

CAN DENTURE ADHESIVES CONTRIBUTE TO ORAL PATHOSIS

Many studies carried in this aspect, believed that denture adhesives could influence oral flora by causing an imbalance in the flora if they were inhibitory to specific organisms, selectively supported the growth some organisms or introduced new micro-organisms into the adhesives. It may have a positive effect in inhibiting inflammation by reducing potential trauma. A decrease in surface keratinisation was observed in some cases and poor oral hygiene gave rise to inflammatory changes in a few.^{6,14}

Beneficial factors of denture adhesives include improved function, greater retention and stability, increased incisal bite force and a sense of comfort both physical and psychological for the patient. Denture adhesive should not be used as a substitute for adequately constructed or properly fitting prosthesis.

As dentist it is our responsibility to be knowledgeable and caring enough to assist each patient in adapting to dental prosthesis. Dental professionals and educators should make a realistic assessment of the proper use of denture adhesives and counsel their patients adequately against misuse. Intelligent assessment can be done only from a valid knowledge base and towards the end, continued research and vigilance into the use of denture adhesives is essential.

REFERENCES

1. Adisman IK. The use of denture adhesives as an aid to denture treatment. *Jour Prosth Dent* 1989; 62 : 711-5.
2. Boone M. Analysis of soluble and insoluble denture adhesives and their relationship of the tissue irritation and bone resorption. *Compend Contin Educ Dent* 1984; 4 (supple) S22-5.
3. Chew CL. Denture stabilisation with denture adhesives and their effect on denture retention and stability. *Compend Contin Educ Dent* 1984; 4 (supple) S2-8.
4. Dewey H Bell. Prosthodontic failures related to improper patient education and lack of patient acceptance. *Jour Prosth Dent* 1972; 16 : 114.
5. Eugene Shore. The edentulous patient : the patient perspective. *Jour Prosth Dent* 1984; 4 (supple) S12.
6. Grasso JI. Effect of denture adhesive on the retention and stability of maxillary denture. *Jour Prosth Dent* 1994; 72 : 399-415.
7. Lindstrom RE. Physical-chemical aspects of denture retention and stability. A review of literature. *Jours Prosth Dent* 1979; 42 : 371.
8. Kapur KK. A clinical evaluation of denture adhesive. *Jour Prosth Dent* 1967; 18 (6) : 550-8.
9. Mackay BJ. Comparative efficacy of powder denture adhesive. *Jour Prosth Dent* 1993; 72 : 376.
10. Mackay BJ. Comparative efficacy of cream denture adhesive. *Jour Prosth Dent* 1993; 72 : 379.
11. Mckervitt FH. The measured vertical dimension and denture adhesive powders. *Jour Prosth Dent* 1951; 1 : 393-401.
12. Ow RKK. A method of studying the effect of adhesives on denture retention. *Jour Prosth Dent* 1983; 50 : 332-7.
13. Samuel YL. A review of denture adhesives. *Jour Prosth Dent* 1951; 1 : 393-401.
14. Strafford GD. Efficiency of denture adhesive and their possible influence on oral micro-organisms. *Jour Prosth Dent* 1971; 50 : 832-6.
15. Tarbet WJ. Effect of denture adhesive on complete denture dislodgement during mastication. *Jour Prosth Dent* 1980; 44 : 374-8.
16. Tarbet WJ. Observation of denture supporting tissue during six months of denture adhesive usage. *Jour Prosth Dent* 1980; 101 : 789-91.
17. Tarbet WJ. Maximal incisal biting force in denture wearers as influenced by adequate denture bearing tissues and use of an adhesive. *Jour Proth Dent* 1981; (60) 2 : 115-9.
18. Yankel SL. Overview of research and literature on denture adhesive. *Compend Contin Educ Dent* 1984; 4 (Supple) : 510-21.